STUDY AREA

The Pryor Mountain Wild Horse Range (PMWHR) is located approximately 47 miles south of Billings, Montana and nine miles north of Lovell, Wyoming. It occupies an area of about 39,651 acres in northern Big Horn County Wyoming and Southeastern Carbon County, Montana (Figure 1, page 46). The land is managed by the Bureau of Land Management (BLM), the lead agency responsible for management of the feral horses, National Park Service (NPS), and the United States Forest Service (USFS).

The PMWHR is an extremely diverse and complex area topographically, geologically, and ecologically. It varies in environment and elevation from a sagebrush / salt-shrub dominated cold desert at about 3,850 feet in Wyoming, to a subalpine setting with subalpine fir (*Abies lasiocarpa*) and open meadows in Montana at about 8,750 feet.

Mean annual precipitation (MAP) varies from six inches in Wyoming to 27 inches at the highest point on the PMWHR in Montana (Figure 2, page 47). This difference occurs over a 13-mile span. Much of this precipitation falls April through June, with rain in the summer and snow in the winter. Temperatures vary between about 104 degrees F in the summer to about -30 degrees F in the winter (NRCS National Water and Climate Center 2002, Western Regional Climate Center 2002).

Three Floristic provinces meet in this area, the Great Plains province to the north and east of the PMWHR, the Great Basin province to the south, and the Rocky Mountain province to the west (Cronquist 1982). Each of these provinces possesses a unique climate and resulting floristic character. At Horseshoe Bend, the southern end of Bighorn Lake and just off of the PMWHR, the elevation is 3600 feet and the MAP is 5.5 inches. Traveling 27 miles northeast to Yellowtail dam, the elevation is 300 feet lower yet the MAP is 13.5 inches greater (19 inches MAP) (Historical Montana precipitation data 1961-1990). Within this relatively short distance, the vegetation has changed from the Great Basin Floristic province (salt desert shrubs) to the Great Plains Floristic province (mid and short grass prairies) in dramatic fashion.

In the Pryor Mountains an intermixture of limestone, sandstone, and shale have weathered to form mostly very shallow (<10 inches) to moderately deep (20-40 inches), loamy soils that are calcareous. Most of the soils contain 35 to 70 percent coarse fragments. Rock outcrops comprise up to 35 percent of the landscapes in the mountains (BLM and SCS 1981). The white Madison limestone formation (Alt 1986) is a characteristic geologic formation.

The soils on footslopes, fans, and terraces along the south side of the Pryor Mountains are forming in an amalgamated mixture of alluvium from limestone, sandstone, and shale. These soils are mainly deep (>40 inches), have high coarse fragments, and are highly calcareous (BLM and SCS 1981).

Just south of the Madison limestone geologic formations and beyond the fans, footslopes, and terraces influenced by them, and from east to west along the state line, the geologic formations are mainly late Paleozoic and Mesozoic (BLM and SCS 1981, Alt 1986). The red Chugwater formation (Alt 1986) is a characteristic geologic formation. The materials in this area are mostly interbedded sandstones, siltstones, and shale. The uplifting, tilting, and erosional processes have

given rise to highly dissected landscapes with numerous narrow intermittent drains. The uplifted backsides of these formations have resulted in the formation of a complex of mainly very shallow to moderately deep, loamy, clayey, and sandy soils that contain from five to 80 percent coarse fragments. Five to 25 percent of these areas consist of rock outcrop or geologic sediments (BLM and SCS 1981). This area contains many fossilized remains.

The uplifted surfaces of the formations have eight to 25 percent slopes. The soils on these surfaces are very shallow to moderately deep. They are clayey, loamy, or sandy depending on the dominant influence of sandstone, siltstone, or shale. The soils on the footslopes, fans, and in the drainage bottoms are mostly deep and loamy. These soils have a high vegetative production potential. To varying degrees they are salt and alkali affected (BLM and SCS 1981).

Soils in the study area have a high hazard for both wind and water erosion. Weather records show that wind gusts up to 70 miles per hour are not uncommon (Montana Climate Information 2002, Western Regional Climate Center 2002). Soils that are sparsely vegetated and only slightly disturbed are subject to a high blowing hazard. Soils high in calcium carbonate (lime) are especially vulnerable to soil blowing (BLM and SCS 1981). Lime contributes to the flocculation of soil particles. This encourages particle detachment from the soil mass allowing particles to become airborne.

During the two summers of the field study, we witnessed four events at the lower elevations during which red, white, or tan dust clouds moved across the area on windy days.

The hazard of water erosion on the PMWHR is high even though the mean annual precipitation is low in the southern and eastern areas of the range (Figure 2, page 47). Most of the precipitation falls from April through June with a high probability of intense rain storms (greater than or equal to two inches of rain per hour) during this period (Montana Climate Information 2002). At this time the very shallow (<10 inches) and shallow (10-20 inches), sparsely vegetated soils with slopes greater than eight percent are subject to a very high hazard of water erosion. The reason these soils are especially vulnerable to water erosion is because they have the capacity to hold less than 0.5 inch to a maximum of four inches of water (BLM and SCS 1981). In many years, these soils reach a maximum of water they can store early in April, resulting in a high runoff potential with additional precipitation, thus creating the high water erosion hazard. Other soils on slopes greater than about 25 percent are also subject to a high water erosion hazard if the vegetative cover is inadequate.

During our field survey a severe rain event occurred in June of 2002. This event filled the drainages with water, piled sediment up to three feet deep across the Sykes fish hatchery road, and created visible rill erosion throughout the desert landscape. Prior to this event, rills were not visible.

Chugwater formation in the Britton Springs inventory unit with rills and erosion flow patterns.

Wind erosion in the National Park inventory unit.